SDSU Extension

iGrow Wheat

BEST MANAGEMENT PRACTICES

Chapter 29:
Estimating Wheat Yield Potentials

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Yield estimates can be used for a variety of purposes ranging from determining how much N to apply to estimating the amount of grain available for marketing. This chapter discusses several techniques for estimating wheat yields.

Rules of Thumb in Estimating Yields

- Yield estimates need to be continuously updated based on information obtained during field scouting (Chapter 21).
- Initial estimates are based on long-term weather averages and previous yields.
- In-season estimates are based on measured plant and/or heads/acre.
- Examples for all calculations are provided.

Yield estimates can be used for estimating nutrient removal, determining fertilizer recommendations, making replanting decisions, and developing pest management recommendations. When estimating yield, it is important to remember that the predictions are only as good as the information collected.

Factors influencing yield variability

In South Dakota, yields are influenced by water and temperature variability. Estimating yield potentials would be easy if we always had average temperatures and precipitation (Fig. 29.1). However, in South Dakota, average climatic conditions are the exception from the norm. Tracking the crop yield potential is one approach to help manage this variability.

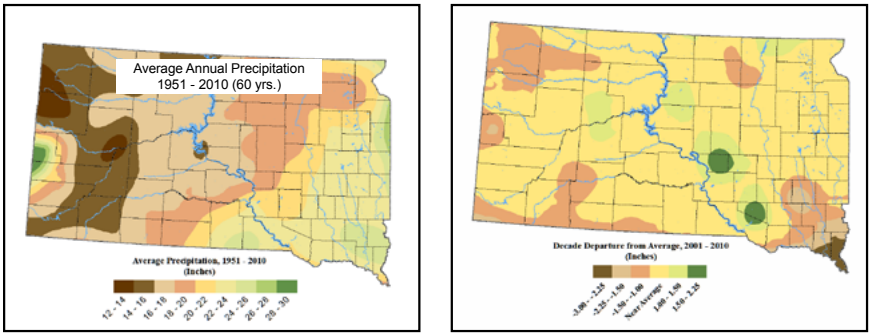

Figure 29.1. Average rainfall from 1951-2010 and rainfall from 2000-2010

Table 29.1. Methods for estimating yield goal. http://www.extension.iastate.edu/Publications/PM1268.pdf

- Remote Sensing.
- Field History (Field).
- Yield goal +, Add 10% to a multiple year average where the maximum and minimum values have been removed.
- Yield goal + moisture, Adjust a multiple-year yield, after outliers have been removed, based on plant available water.
- County Average.
- Productivity Index.

Estimating preplanting yield potential

Preplant yield potentials can be estimated using remote sensing or averaged from prior yield records (Table 29.1; Chapter 16; Reitsma et al. 2011). Prior yield records are used to determine the field average. In this calculation, the outliers are removed from the data set. There are many modification of this basic method. For example, the average value can be increased or decreased 10% based on soil moisture (Table 29.2).

Table 29.2. An example showing how a wheat yield goal is determined from multiple years of data.

Field records

Year	Yield (bu/A)	Conditions
~~1~~	~~10~~	Poor
2	40	Average
3	50	Average
4	47	Average
5	52	Average
~~6~~	~~15~~	Poor
7	48	Average
8	63	Excellent
9	61	Excellent
10	53	Average
Potential	*52	Average
* Predicted Values		

The yield goal + moisture recommendation would be:

Full soil profile

52 + 0.10 • 52 = 57 bushels

Average soil profile

52 bushels

Poor moisture conditions

52 - 0.10 • 52 = 47 bushels

For this approach a producer should be prepared to add additional fertilizer if needed.

Estimating winter wheat yields prior to tillering and stem elongation

Wheat yield estimates prior to tillering can be used for replanting decisions and determining in-season N application rates (Chapters 11, 15). These calculations are based on several assumptions. *First*, soil moisture, nutrients, and diseases will have minimum impact on yields. *Second*, each plant produces 5 heads and each head contains 22 kernels. *Third*, a bushel of wheat at 13.5% moisture weights 60 lbs and a pound of wheat contains 16,000 kernels.

It is important to point out that in many situations, tillering decreases with increasing planting rate and the head per plant, and tillers per head can be impacted by planting date.

Table 29.3 shows the calculations needed for this estimation, while Table 29.4 provides information for various plant distributions.

Estimating spring wheat yields prior to tillering and stem elongation

Spring wheat yield estimates prior to tillering requires a small adjustment. The number of heads per plant is slightly lower in spring than winter wheat. Hanson (2001) reported that in North Dakota, 4.6 heads per plant are produced when wheat is planted at 0.5 million seeds/acre and 2.1 heads per plant are produced when planted at 2 million seeds per acre. He also reported that the number of kernels per head is impacted by population. For a population of 0.5 million seeds/acre, each head contained 25 kernels and for a population of 2 million seeds per acre, each head contained 20 kernels.

Yield estimates for winter and spring wheat near maturity

Yield estimates near maturity are used for harvest planning and marketing decisions. In the following calculations we will make two assumptions, a pound of wheat contains 16,000 kernels and a bushel of wheat at 13.5% moisture weighs 60 lbs. In these calculations, it is important to remember that 1 acre = 43,560 ft^2.

To estimate yield, the number of kernels per head, heads per foot of row, and row spacing must be measured (Table 29.5). Accuracy is improved by increasing the sampling size, or the number of locations where the counts are made. Guidelines for these calculations are that the number of head in a foot of row should be measured in at least five locations. Count the number of kernel per head in at least five heads per location. Because the head size diminishes on tillers, the kernel counts should be made on both main and tiller heads. Sample calculations are below.

Table 29.3. Estimating yield potential prior to tillering

1. Count the number of plants per foot of row
   a. Measure plants in 5 feet of row in at least 5 locations.
   b. These locations should represent the field conditions.
2. Measure the distance between the rows.
3. Calculate the yield potential.

$$\frac{\text{bu}}{\text{acre}} = \frac{\text{plant}}{\text{ft row} \times (\text{row width in inches}) \times {}^{1\text{ft}}/_{12\text{ inches}}} \cdot \frac{\#\text{heads}}{\text{plants}} \cdot \frac{\#\text{kernels}}{\text{head}} \cdot \frac{\text{lb}}{16{,}000\text{ kernels}} \cdot \frac{\text{bu}}{60\text{lbs}} \cdot \frac{43{,}560\text{ ft}^2}{\text{acre}}$$

$$\frac{\text{bu}}{\text{acre}} = \frac{\text{plant}}{\text{ft row} \times (\text{row width in inches}) \times {}^{1\text{ft}}/_{12\text{ inches}}} \cdot \frac{5\text{ heads}}{\text{plants}} \cdot \frac{22\text{ kernels}}{\text{head}} \cdot \frac{\text{lb}}{16{,}000\text{ kernels}} \cdot \frac{\text{bu}}{60\text{lbs}} \cdot \frac{43{,}560\text{ ft}^2}{\text{acre}}$$

$$\frac{\text{bu}}{\text{acre}} = \frac{\text{plant}}{\text{ft row} \times (\text{row width in inches}) \times {}^{1\text{ft}}/_{12\text{ inches}}} \cdot \frac{5\text{ bu} \times \text{ft}^2}{\text{plants} \times \text{acre}}$$

Example: If a wheat field contains 5 plants/foot and the row spacing is 7.5 inches, what is the yield potential?

$$\frac{\text{bu}}{\text{acre}} = \frac{5\text{ plant}}{\text{ft row} \times 7.5\text{ inches} \times {}^{1\text{ft}}/_{12\text{ inches}}} \times \left(\frac{5\text{ bu} \times \text{ft}^2}{\text{plants} \times \text{acre}}\right) = \frac{25\text{ bu}}{0.625\text{ acre}} = \frac{40\text{ bu}}{\text{acre}}$$

Table 29.4. Winter wheat yields can also be estimated from the table below.
(Modified from Lyon and Klein 2007)

Row Spacing (inches)	Plants/foot row				
	1	3	5	7	9
6	10	30	50	70	90
7.5	8	24	40	56	72
10	6	18	30	42	54
14	4	13	22	30	39

Table 29.5. Estimating yield in a crop nearing maturity.

$$\frac{\text{bu}}{\text{acre}} = \frac{\text{head}}{\text{ft row} \times (\text{row width in inches}) \times {}^{1\text{ft}}/_{12\text{ inches}}} \cdot \frac{\#\text{kernels}}{\text{head}} \cdot \frac{\text{lb}}{16{,}000\text{ kernels}} \cdot \frac{\text{bu}}{60\text{lbs}} \cdot \frac{43{,}560\text{ ft}^2}{\text{acre}}$$

$$\frac{\text{bu}}{\text{acre}} = \frac{\text{head}}{\text{ft row} \times (\text{row width in inches}) \times {}^{1\text{ft}}/_{12\text{ inches}}} \cdot \frac{\#\text{kernels}}{\text{head}} \cdot \frac{0.5445}{\text{row(inches)}}$$

Example: If a wheat field contains 30 heads/ft and 22 kernels/head, what is the yield estimate if the row spacing is 7.5 inches?

$$\frac{\text{bu}}{\text{acre}} = \frac{30\text{ heads}}{\text{ft row}} \times \frac{22\text{ kernels}}{\text{head}} \times \frac{0.5445}{7.5} = 51.3{}^{\text{bu}}/_{\text{acre}}$$

Additional information and references

Hanson, B. 2001. Planting rate influence on yield and agronomic traits of hard red spring wheat in northeastern North Dakota. NDSU Ag Report. NDSU, North Dakota Experiment Station. Available at http://www.ag.ndsu.nodak.edu/aginfo/agreport/ar1w.htm

Lyon, D.J., and R.N. Klein. 2007. Estimating winter wheat yields. Neb Guide G1429. University of Nebraska-Lincoln Extension, Institute of Agriculture and Natural Resources. Available at http://elkhorn.unl.edu/epublic/live/g1429/build/g1429.pdf

Reitsma, K.D., R.K. Heimerl, and T.E. Schumacher. 2011. Estimating soil productivity and energy efficiency using the USDA Web Soil Survey, soil productivity index calculator, and biofuel energy system simulator. In Clay D.E. and J.F. Shanahan. (eds.) GIS Applications in Agriculture: Nutrient Management for Energy Efficiency. Volume 2. CRC Press and NC SARE. New York, NY.

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Clay, D.E., and C.G. Carlson. 2012. Estimating wheat yield potentials. In Clay, D.E., C.G. Carlson, and K. Dalsted (eds). iGrow Wheat: Best Management Practices for Wheat Production. South Dakota State University, SDSU Extension, Brookings, SD.